Ultrasound Guided Modified Pectoral Nerves Block versus Thoracic Paravertebral Block for Perioperative Analgesia in Major Breast Surgery

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Abstract

Background: This study evaluated the safety and complications between the ultrasound guided modified pectoral block versus thoracic paravertebral for perioperative analgesia after mastectomy.

Methods: Forty patients scheduled for ultrasound guided modified pectoral block and thoracic paravertebral block into two equal comparable groups. The first group (Group I) received modified pectoral block while the second group (Group II) received thoracic paravertebral block. Evaluated variables included total intra operative fentanyl consumption, VAS in PACU, sedation score, 24hr morphine consumption, VAS before discharge, hospital stay and patient satisfaction post-operative by 1 week.

Results: Pectoral group and para vertebral group there is significantly difference in VAS in PACU, VAS before discharge between the 2 groups, and no significant differences in sedation score, postoperative 24hr morphine consumption and 1st rescue analgesia.

Conclusions: Our findings suggest that the ultrasound guided modified pectoral block is a good alternative to thoracic paravertebral block to control perioperative pain in breast surgery.

Key Words: Ultrasound – Modified Pecs – Thoracic paravertebral – Block.

Introduction

Breast cancer is the 2nd most common tumors in women. Until now, oncologic breast surgeries are typically performed by General Anesthesia (GA). However, GA cannot provide adequate postoperative pain control and routine use of parenteral opioids aggravate postoperative sedation, nausea, emesis, impaired oxygenation and depressed ventilation. The neural supply of the anatomical structures involved in breast surgery is not well understood when it comes to providing analgesia for perioperative pain relief. Paravertebral block became the gold standard techniques to achieve this goal, but not every anesthesiologist is comfortable performing these procedures. As an alternative for these techniques we designed pectoral nerve block [1].

The modified PECS block produces excellent analgesia and can be used to provide a balanced anesthesia and as a rescue block in cases where the analgesia provided by the paravertebral or epidural was patchy or ineffective [2].

Thoracic wall blocks (PECS I, PECS II and Serratus plane block) are peripheral nerve block alternatives to paravertebral block for providing both surgical anesthesia and postoperative analgesia for breast surgery. All rely on local anesthetics placement between the thoracic wall muscles. Thoracic wall blocks in chest are resemble to TAP (transversus abdominis plane) block in abdomen. Thoracic wall blocks introduction has been facilitated by the widespread availability of portable ultrasound. The Pecs block is a recently described, easy and reliable superficial block that targets the lateral and median pectoral nerves at an interfascial plane between the pectoralis major and minor muscles. It can be used for different breast operations, other potential indications are
traumatic chest injuries, iatrogenic pectoral muscle
dissections, pacemakers, portacaths and chest
drains [3].

The pectoral nerves are major nerves arising
from the brachial plexus innervating the pectoral
muscles. The lateral pectoral nerve most commonly
arises from C5, C6 and C7, and the median pectoral
nerve from C8 and T1. The lateral pectoral nerve
is the bigger of the two and runs between the major
and minor pectoral muscles in a fascial plane in
close proximity to the pectoral branch of the tho-
racoacromial artery and innervates the Pectoral
major muscle. The medial pectoral nerve runs
under the pectoral major muscle. It crosses the
muscle to reach the lower third of the pectoral
major muscle in the pectoral region after piercing
the two layers of the clavipectoral fascia. Various
groups agree that the medial pectoral nerve crosses
pectoral major muscle in 62% of the patients, while
in the remainder it is located on its lateral border.
Thoracic paravertebral blockade is a century old
technique used for intra-operative and perioperative
pain control. The block may be performed as a
single shot or by placement of an indwelling cath-
eter, and a patient’s opioid requirement may be
decreased [4].

Many practitioners, however, remained hesitant
to perform thoracic paravertebral blocks secondary
to the associated risk of pneumothorax, reported
to be 0.5%-2% in addition to the risk of dural
puncture with some of the older medially directed
landmark approaches. The growth of ultrasound
technology increase our ability to visualize the
pleura and other structures in and around the par-
avertebral space reduce incidence of complication.
These blocks may be used for acute pain control,
as an adjunct to general anesthesia for perioperative
pain control [5].

**Patients and Methods**

Our study done at National Cancer Institute,
Cairo University since 2014 till 2016, after obtain-
ing approval from the local ethical committee and
patients consent, forty patients suffering from upper
limb neuropathic pain will be randomized into two
equal comparable groups. The first group (Group
I) received modified PEC’s block through anterior
approach while the second group (Group II) re-
cieved thoracic paravertebral block through lateral
approach both under ultrasound guidance.

**Inclusion criteria:**

1- Age of the patient between 20 to 80 years.
2- Patient underwent breast surgery.
3- Patients ASA status I-IV.

**Exclusion criteria:**

1- Coagulopathy.
2- Local infection.
3- Cognition disorders.
4- Failure to get consent.
5- Emergencies.

**Technique:**

A- **Patient preparation:** History taking, physical
examination, CBC and coagulation profile will be
done for all patients. The patient was supine while
performing the pecs block and sitting in thoracic
paravertebral and sterilization of the site of the
ultrasound and needle entry was performed.

B- **The procedure:** All the blocks were per-
formed in the operating room where all resuscitation
equipment available with SonoSite M-Turbo ultra-
sound machine using 6-13MHz probe. Intravenous
midazolam in a dose of 0.05mg/kg was given to
all patients and fully monitored by ECG, blood
pressure and pulse oximetry. The patient was placed
in the supine position with abducted arm in Group
1 but in sitting position in Group 2.

**The ultrasound guided pecs block (Group 1):**

The patients will be positioned supine with the
ipsilateral arm abducted and externally rotated.
The infra-clavicular and axillary regions were
cleaned with chlorhexidine. The skin point of
puncture is infiltrated with 2% lidocaine and once
the structures are identified with ultrasound. The
probe is positioned under the lateral third of the
clavicle. After locating the subclavian artery, the
axillary artery and the axillary vein we move the
probe distally towards the axilla, until the pectorals
major muscle is identified. We start counting the
ribs, from 1st rib under the axillary artery and
maintaining the pectorals major as a reference, we
move distally and laterally until the lateral border
of pectorals major is reached. Serratus anterior
muscle cover 2nd, 3rd, 4th rib, this point being the
entrance into the anterior axillary line we use
atraumatic needle with extension line and electrode
for nerve stimulator (Stimuplex D). We will use
one needle approaches instead of two. We will
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Inject 10ml of local anesthetic between the pectorals muscles firstly then inject 20ml of local anesthetic between the pectorals major muscle and the serratus muscle. The onset time of analgesia is three minutes on average, and analgesia lasts for 8 hours. The block is performed with the patient fully awake, followed with a general anesthetic.

*The ultrasound guided thoracic paravertebral block (Group B):*

The probe was been placed over a spinous process in the mid-line in a longitudinal fashion. The probe is then moved laterally to visualize the transverse process, the point at which the transverse process and the rib intersects, the superior costotransverse ligament and the pleura with lung tissue visualized anteriorly. This scan is often conducted more easily in a lateral to medial fashion. The point at which the transverse process and the rib intersects represents the lateral aspect of the paravertebral space, and it is generally approximately 2.5-3cm from the mid-line. Turn the probe in a lateral transverse fashion and visualize the transverse process, the shimmering pleura which dips medially and the lung tissue anterior to the pleura. It is important to differentiate between the pleura and the rib with the probe placed in a transverse fashion. The rib is more superficial with dropout seen beneath it using ultrasound. The pleura is deeper, "shimmers" and moves with respiration, and lung tissue anterior to the pleura. After this, 10-20cc of local anesthetic is injected in 3-4cc increments.

**General anesthesia technique:**

Anesthesia will be induced after intervention done with I.V. fentanyl 1-2 g/kg I.V., propofol 2mg/kg and An I.V. bolus of rocuronium 0.5mg/kg will be also given to facilitate tracheal intubation. Anesthesia will be maintained with sevoflurane and additional bolus doses of fentanyl 0.5-1 g/g/kg, IV acetaminophen and IV ketrolac to avoid arterial pressure values above 20% of baseline. Patients will be ventilated in a pressure-controlled volume guaranteed mode at tidal volumes of 6-8ml/kg, at respiratory rates to maintain end-tidal carbon dioxide concentration between 4.9-5.7 and 5.3-5.9 kPa, with a positive end-expiratory pressure of 5 mbar, and an inspired oxygen fraction (FIO₂) of 0.6. After reversal of neuromuscular blocking agent and response to verbal command, patients will be extubated in the operating theatre. They will be then transferred to the PACU. Postoperative analgesia will be provided by IV morphine 3mg for the first 24h on demand for patient with VAS more than 3. Patients will be discharged to surgical ward after fulfilling our criteria for discharge from the PACU.

**Monitoring and data collection:**

- **Intraoperative:**
  - Total fentanyl consumption during surgery.
  - Average end tidal sevoflurane percentage.
- **Postoperative:**
  - Demographic characteristics.
  - Total fentanyl consumption during surgery.
  - Average end tidal sevoflurane percentage.
  - Sedation score in PACU according to modified Ramsay score.
  - Pain intensity will be assessed in the PACU with the Visual Analogue Scale (VAS).
  - Any complications will be detected.
  - Nausea and vomiting.
  - Postoperative Morphine requirements (1st 24h).
  - VAS before discharge from the hospital.
  - Hospital stay.
  - Patients' satisfaction with postoperative analgesia through a phone call a week after surgery. On 5-level likert scale, (not satisfied at all, only slightly satisfied, somewhat or partly satisfied, very satisfied, perfectly satisfied.

**Results**

In comparison between pec s group and para vertebral group there is significantly difference in VAS in PACU, VAS before discharge between the 2 groups, and no significant differences in sedation score, post operative 24hr morphine consumption and 1st rescue analgesia.

The incidence of post operative nausea and vomiting markedly decreased in Group 1 & 2, it was about 10% in Group 1 and 19% in Group 2.
Ultrasound Guided Modified Pectoral Nerves Block versus Thoracic Paravertebral Block

Fig. (1): Ultrasound image showing Pectorals Major Muscle (PMM), Pectorals Minor Muscle (PmM), serratus anterior muscle, Thoraco-Acromial Artery (TAA), pleura and lung.

Fig. (2): Ultrasound image showing separation between Pectorals Major Muscle (PMM) and Pectorals Minor Muscle (PmM) after injection of local anesthetics.

Fig. (3): Ultrasound guided image of thoracic para vertebral space T4, T5 demonstrate the TP: Transverse process, red arrow (superior costotransverse process), blue arrow (pleura).

Fig. (4): Needle enhancement program show needle piercing the superior costotransverse ligament (red line) and injected local anesthetic pushing the pleura (blue line) down.

Fig. (5): Nausea and vomiting in two groups. The incidence of complication present in Group 2 with no complication detected in Group 1.

Table (1): Difference between Group 1 and Group 2.

<table>
<thead>
<tr>
<th></th>
<th>Group 1 pecs block</th>
<th>Group 2 thoracic paravertebral block</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sedation score</td>
<td>Mean .44 1.00 1.00 2.00</td>
<td>Mean .44 1.00 1.00 2.00</td>
<td>.93</td>
</tr>
<tr>
<td>• VAS in PACU</td>
<td>2.95 .30 2.00 6.00</td>
<td>3.90 1.18 2.00 6.00</td>
<td>.003</td>
</tr>
<tr>
<td>• Postoperative morphine consumption in 1st 24hr</td>
<td>3.60 3.53 3.00 .00</td>
<td>4.43 4.51 3.00 .00</td>
<td>.615</td>
</tr>
<tr>
<td>• VAS before discharge</td>
<td>1.50 .89 1.00 1.00</td>
<td>2.38 1.28 3.00 1.00</td>
<td>.018</td>
</tr>
<tr>
<td>• 1st rescue analgesia (hours)</td>
<td>5.20 4.79 6.00 .00</td>
<td>4.95 3.50 4.00 .00</td>
<td>.789</td>
</tr>
</tbody>
</table>
Table (2): Type of complications detected.

<table>
<thead>
<tr>
<th>Any complication detected:</th>
<th>Group 1 pecs block</th>
<th>Group 2 thoracic paravertebral block</th>
<th>( p ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>%</td>
<td>Count</td>
<td>%</td>
</tr>
<tr>
<td>Urine retention</td>
<td>0</td>
<td>.0</td>
<td>0</td>
</tr>
<tr>
<td>Pruritis</td>
<td>0</td>
<td>.0</td>
<td>0</td>
</tr>
<tr>
<td>Pneumothorax</td>
<td>0</td>
<td>.0</td>
<td>2</td>
</tr>
<tr>
<td>No</td>
<td>20</td>
<td>100.0</td>
<td>19</td>
</tr>
</tbody>
</table>

No significant difference between hospital stay in the three groups.

Table (3): Hospital stay duration in two groups.

<table>
<thead>
<tr>
<th></th>
<th>Group 1 pecs block</th>
<th>Group 2 thoracic paravertebral block</th>
<th>( p )-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>27.00 9.44</td>
<td>32.00 15.80</td>
<td>0.541</td>
</tr>
<tr>
<td>SD</td>
<td>12.00</td>
<td>24.00</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>24.00</td>
<td>24.00</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>12.00</td>
<td>24.00</td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>48.00</td>
<td>72.00</td>
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</tbody>
</table>

Discussion

The neural supply of the anatomical structures involved in breast surgery is not well understood when it comes to providing analgesia for perioperative pain relief. Paravertebral block became the gold standard techniques to achieve this goal, but not every anesthesiologist is comfortable performing these procedures. As an alternative for these techniques we designed pectoral nerve block [1].

Blanco described an interfascial plane block for breast surgery as a novel peripheral nerve block alternative to neuraxial and paravertebral blocks for ambulatory breast surgeries [2]. In this technique, which he termed "Pecs block," local anesthetic was deposited between the pectoralis major and pectoralis minor muscles to anesthetize the lateral and medial pectoral nerves providing analgesia to the chest wall (Pecs I) [2].

Blanco reported a variation of his original technique by performing his original Pecs I block and then adding an additional local anesthetic injection between the serratus anterior and pectoralis minor muscles (Pecs II). This modification aimed to extend analgesia to the axilla [6]. Whilst pectoralis minor block I is still good for breast expanders’ surgeries. Furthermore, he compared this technique with paravertebral and thoracic epidural in breast surgeries, concluded that it is quite safer, less incidence of pneumothorax than paravertebral block and no sympathetic nerve block as thoracic epidural did. As many breast surgeries are performed on an outpatient basis, these may be a safer alternative for this patient population. Additionally, the Pecs blocks are not as restricted by use anticoagulants as paravertebral or neuraxial blocks. This allows a greater subset of patients to qualify for block placement and possibly minimize interruptions in anticoagulation when not medically desirable [7]. Moreover, blanco mentioned that it decreased incidence of tumor recurrence and considered as simple and fast technique as well. The modified technique provided also blocking of anterior parts of inter-costal nerves which you cannot guarantee with pectoralis minor block I. On the other hand, intravascular injection complication in pectoral branch of the acromio-thoracic artery was considered to be more likely with pectoralis minor block as one of it is main adverse effects [3].

Perez et al., also described a different approach for pecs block and reported decreased perioperative systemic analgesic requirements and improved patient satisfaction in major and minor breast surgeries. The ultrasound probe is placed below the outer third of clavicle after identifying 4 structures PMm, Pmm, thoraco-acromial artery and cephalic vein the needle introduced in plane with ultrasound probe from medial to lateral. They claimed that their approach stay far from the pleura and blood vessels and avoids blocking the needle path through coracoid process [8].

The trial of Sopena-Zubiria et al., patients enrolled in the study had minor breast surgery; sub-pectoral implants. The main shortage of adequacy of TPVB is unmasked during axillary dissection. In presence of axillary dissection, TPVB was reported to have inadequate block. Therefore; Pecs block may be more efficient after surgery with axillary dissection [9].
About intraoperative fentanyl consumption was lower in pecs group which mean was $130 \pm 47.02$ mic rather than paravertebral which mean was $145.24 \pm 54.55$mic as the same result with sherif Samir et al., 2013, the study was thoracic paravertebral block versus pectoral nerve block for analgesia after breast surgery which published in egypt journal of anesthesia this study done on sixty patient under done elective modified radical mastectomy, this prospective randomized study showed that Pecs block performed in patients before MRM resulted in less postoperative morphine consumption in the first 24h with lower intensity of pain in the first 12h in comparison with PVB. Moreover, intraoperative fentanyl consumption was significantly lower in patients of Pecs group in comparison with PVB group. However; pain intensity was lower in the 2nd 12h in patients who received PVB. Patients’ satisfaction was almost comparable between both techniques in respect to postoperative analgesia. The intraoperative fentanyl consumption for pecs group was 105mic and for paravertebral was 127.5mic, also in this study showed that the 1st rescue of morphine in pecs group was significantly longer 175min than in the TPVB group 137.5 but in our study in pecs group 5.20 hr. And in TPVB group was 4.95±3.50hr [10]. In our study the incidence of nausea and vomiting in pecs and TBVB groups was significant lower, it was about 10% in pecs group and 19% in TBVB group which consistent with Fahy et al., who approved that 18-26% decrease in postoperative nausea and vomiting after preoperative TPVB [11]. Rafik et al., in his study that done on 60 patients, half of them received pectoralis block (first group) and other half got thoracic paravertebral block (second group) for postoperative analgesia. Show the incidence of nausea and vomiting in pecs group was 53.3% but in TPVB was 53.3% [12]. In other side Haure et al., in his study published 2015heimer between pecs and TIVA and the other group was TIVA only there is no significantly difference in the nausea and vomiting incidence, 90 also be showed that the lack of significant differences in the administration of postoperative supplemental analgesics may be explained by the following observations. PECSB cannot block the anterior cutaneous branches of the intercostal nerves, which innervate the nearby sternum; therefore, the internal mammary region in the surgical site may not be blocked by PECSB [13].

**Conclusion:**

Breast surgery is associated with severe postoperative pain, and, on the other hand, auxiliary clearances are also often part of the surgery. We needed to find a single block that can cover all pain sources.

In conclusion our study suggest that modified Pecs block is easy and reliable superficial block that targets the lateral and median pectoral nerves at an interfascial plane between the pectoralis major (PMM) and minor (Pmm) muscles. Which is a good alternative and safe technique rather than thoracic paravertebral block.

**References**


الملخص العربي

سرطان الثدي هو السرطان الأكثر شيوعاً في النساء، وحوالي (78-88%) من جميع أنواع السرطان التي تؤثر على الأثنا، آلام ما بعد الجراحة هي واحدة من أكبر مخاوف المريض بعد أي عملية جراحية، وعلى الرغم من زيادة التركيز على التحكم في الآلام ما بعد الجراحة، ما يقرب من 80% من المرضى يعانون من الألم بعد العملية الجراحية ومنهم ما يقرب من 88% من المرضى تقيم الآلام يترانح ما بين المتوسطة والبحث.

المريضين الذين يخضعون لجراحة الثدي تتطلب التدخين بطرق شتات لعلاج الألم بعد الجراحة والتي توفر تسكن للألم بقل أعراض جانبية.

حتى الآن، وعادة ما تجري جراحات الثدي الأورام عن طريق التخدير الكلي الذي لا يوفر الهدف المرجو من تسكن الألم حيث أنه يتطلب إعطاء جرعة كبيرة من المواد المخدرة مما يربط عليها الكثير من الآثار الجانبية على سبيل المثال القلق، الغثيان، إخصاب معدل التنفس ونسبة الأكسجين بالدم.

للهذا السبب ظهرت طرق شتات التحكم في الألم ما بعد إجراء جراحات الثدي وتقليد الآثار الجانبية للمواد المخدرة ومنها حقن المخدر الموضعي في مكان الجراحة، غلاف الأعصاب المركزية المغنية لمنطقة الثدي وتخدير الأعصاب الطرفية.

ومما يزيد الأمر صعوبة أن الأعصاب المغنية للثدي ليست واضحة وضوح تام حيث أنها مجموعه معقدة من الأعصاب التي يصعب التحكم فيهم جريمه بطريقة واحدة، غلاف الأعصاب الجلدية للفقرات الصدرية أصبحت الطرقية الأمثل المعترف عليها ولكن ليس كل أطباء التخدير يستطيعون إجراء هذا التدخل لذلك تكونت الالتفافات إلى البحث عن طريقة أخرى أمنة.

لذلك نشاهد فكرة غلاف الأعصاب الصدرية الموجودة بين عضلات الصدر التي تشارك بشكل كبير في تفكيك منطقة الثدي وتحت الإبط وتعتبر تلك الطريقه من إحدى الطرق الأمثل والفعالة للتحكم في الألم ما بعد إستئصال الثدي والخدم الليمفاوية من تحت الإبط وتستخدم تلك الطريقه أيضا في تركيب القسطرة الوريدية المركزية وتركيب منظم ضربات القلب.